

## OTM Unit Operation

Eric H. Shreiber and Bart A. van Hassel

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### 1. INTRODUCTION

Currently, the typical oxygen-blown IGCC processes are revolved around a coal gasifier that utilizes cryogenically-produced oxygen. These processes suffer from the lack of thermal synergy between the low-temperature oxygen production and the high-temperature gasifier operation. A higher level of thermal integration can be achieved if the oxygen could be produced from air in the temperature range at which the coal gasifiers operate. This high-temperature oxygen production can be achieved using Praxair's Oxygen Transport Membrane (OTM) technology. Through Praxair's OTM technology, IGCC processes can be developed that include a significantly higher level of thermal integration over current processes. This increases process efficiency and can lower the cost of electricity. The objective of this document is to provide the inlet and outlet stream temperatures, pressures, and compositions for an OTM unit that is used to supply oxygen to an oxygen-blown gasifier in an IGCC process.

### 2. THE OTM "BLACK BOX"

Figure 1 shows an IGCC process in which an Oxygen Transport Membrane (OTM) "Black Box" is used to produce the oxygen required for a Shell Gasifier. Praxair's OTM technology is not limited to the Shell Gasifier; this technology can provide high-temperature and high-purity oxygen for use in any type of gasifier. Figure 2 shows a process in which a Solid Oxide Fuel Cell (SOFC) is integrated with both the Shell Gasifier and the OTM "Black Box". In both figures, the input and output streams for the OTM "Black Box" are shown in **red**. HYSYS and GTPro were used to simulate the processes.

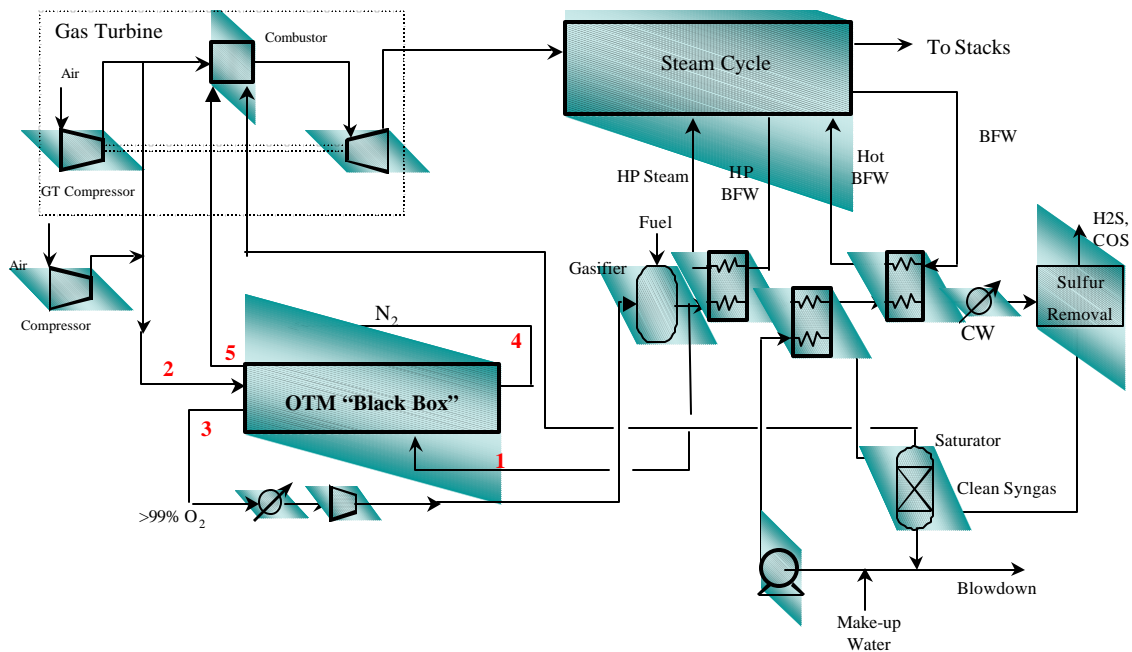


Figure 1- Integrated OTM-IGCC Process Using A Shell Gasifier

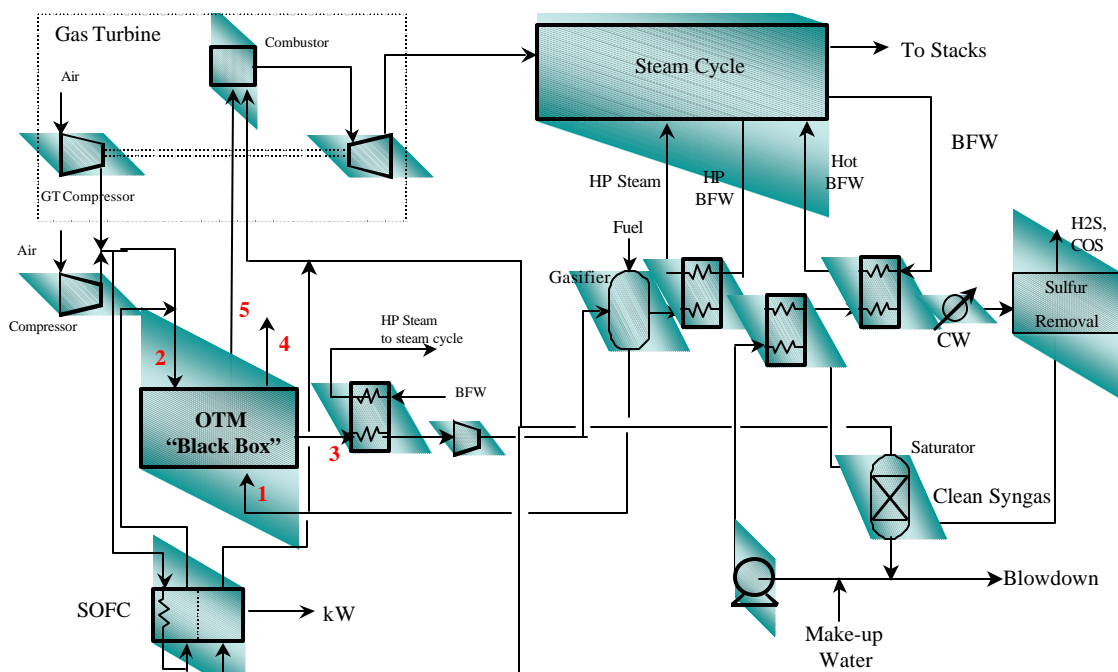


Figure 2- Integrated OTM-SOFC-IGCC Process Using A Shell Gasifier

Table 1 and 2 give the stream summaries for the processes shown in Figures 1 and 2, respectively.

Table 1- Stream Summary Of The OTM “Black Box” For The IGCC Process Shown In Figure 1

Stream #	Temp. (°F)	Pressure (psia)	Flowrate (lbmol/hr)	O <sub>2</sub> (%)	N <sub>2</sub> (%)	H <sub>2</sub> O (%)	CO <sub>2</sub> (%)	Ar (%)	H <sub>2</sub> (%)	CO (%)	CH <sub>4</sub> (%)	H <sub>2</sub> S (%)
1	627	318	8745	0	3.9	0.3	1.8	tr	30.2	63.7	0.04	tr
2	866	298	142158	20.7	77.2	1	0.03	0.9	0	0	0	0
3	1661	18	6370	100	0	0	0	0	0	0	0	0
4	889	290	1019	0	97.6	1.2	0.04	1.2	0	0	0	0
5	1661	293	139426	13.7	78.3	2.9	4.1	0.9	tr	tr	tr	tr

Table 2- Stream Summary Of The OTM “Black Box” For The IGCC Process Shown In Figure 2

Stream #	Temp. (°F)	Pressure (psia)	Flowrate (lbmol/hr)	O <sub>2</sub> (%)	N <sub>2</sub> (%)	H <sub>2</sub> O (%)	CO <sub>2</sub> (%)	Ar (%)	H <sub>2</sub> (%)	CO (%)	CH <sub>4</sub> (%)	H <sub>2</sub> S (%)
1	627	318	40	0	3.8	0.03	1.8	tr	30.2	63.7	tr	tr
2	1641	294	131664	15.9	82.1	1	0.03	1	0	0	0	0
3	1661	16	8852	100	0	0	0	0	0	0	0	0
4	894	292	1426	0	97.6	1.2	0.03	1.2	0	0	0	0
5	1652	292	121337	9.9	87.2	1.1	0.06	1.1	0	0	0	0

### 3. CONCLUSIONS

Superior IGCC processes can be developed through the use of Praxair’s OTM technology. These processes have all the benefits that are associated with oxygen-blown gasifiers without the thermal inefficiency that is associated with processes that use cryogenically-produced oxygen. Continued improvements in Praxair’s OTM technology will lead to further improvements in IGCC processes.